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would not work for his food so long as his parents would go and bring it to him. The first young one was only twenty-one days old when it left the home roof for good, although it could hardly have fed itself for some time afterwards.

Judging from the fact that one young bird was brown, I believe it was a female, while the one that was mostly gray I believe was certainly a male on account of his screech.

The call notes were very interesting, although the female made no sound beyond an occasional faint hiss. The quacking of the male is undoubtedly a warning call. I could not decide upon any meaning for his soft, bow-string note, but it was very musical and quite unlike anything that would be expected from a Night-hawk. The repetition of the courtship flight and song of the male to the female, when both old and young were flying together high in air, was surprising and interesting. His singing had stopped almost altogether after the eggs were laid, and during courtship I never saw the song flight when the female was in the air. The young at first have a faint chicken-like "peep," but discontinue it at a very early age and are very quiet.

I believe the food given the young must consist of soft insects, for the most part, as a careful examination of a large number of droppings revealed no signs of hard wing-cases or beetles. Neither were there any bits of clam shell, so it is possible that clam shell may be given to make the young disgorge the pieces of beetle found with it in the pellet.

*The Woodstock, Tacoma, Wash.*

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## THE HISTORY AND PURPOSES OF BIRD BANDING.

BY FREDERICK C. LINCOLN

The entrance of the Bureau of Biological Survey, United States Department of Agriculture, into the field of bird banding will be viewed with interest by the students of this method of ornithological research. In the present paper the author endeavors to present a brief review of the subject from the historical aspect and to outline the problems that it is hoped will be solved by this method of investigation.

In studying the literature of earlier days, casual notes are found relative to the marking of a bird or brood for the elucidation of some pertinent question. This would indicate that the possibilities of such a means of study were not totally unappreciated by the early naturalists but the methods that they employed were too crude to produce important results. Flight or tail feathers were marked with indelible ink or paint; thin metal discs were glued to these feathers; parchment memoranda were tied to some part with silk thread; or the feet, bill or plumage were mutilated in a distinctive fashion.

Obviously none of these practices was satisfactory; and in many cases could, at best, last only until the succeeding molt. The general neglect of the tarsi for the attachment of identifying insignia seems particularly surprising today, since it is now readily apparent that no other part of the bird's body is so satisfactory to carry these marks. The first record of a bird marked on the tarsus that has come to my attention is that of a Great Gray Heron (*Ardea cinerea*) captured in Germany in 1710 carrying several metal rings, one of which (so the reference states) had been attached in Turkey several years previous. This record is interesting and it is regretted that full details are not available. Moreover, since this appears to be the first use of a metallic ring for this purpose, it would be a matter of considerable interest if the kind of metal were known. Nickel and aluminum were not extensively worked at that period and it therefore seems probable that silver was used, as neither iron nor brass would have lasted for "several years" on the foot of a bird that spent so much of its time in water. In subsequent investigations these two metals were used, with precisely the result that should have been expected, rust and corrosion to the total destruction of the bands.

In 1804, a Dutch naturalist, Brugmann by name, undertook to mark a number of White Storks (*Ciconia alba*) in an effort to learn whether they habitually returned to the place of their birth. His manner of marking is not known but as his birds returned (if they did) without the marks, nothing was gained. The only importance that can attach to this experiment is the fact that in the latter part of the same century the White Stork again figured in one of the most important of modern European investigations in bird migration.

Following this, a few sporadic attempts at bird banding were made by European investigators, but nothing of importance was done until 1899, when Herr Chr. C. Mortensen, of Viborg, Denmark, commenced to band and systematically to record Storks, Teals, Starlings and two or three birds of prey. Herr Mortensen may well be called the pioneer in scientific bird banding.

Stimulated by the success of the Danish ornithologist, bird banding in Europe came rapidly into prominence, so that by 1914 eighteen or twenty distinct projects were either in full operation or were about to be started. Few countries were without their representative schemes and but for the outbreak of international hostilities important results might have been achieved through the coordination of their activities. These were located and had their date of origin as follows: The German Ornithological Society's bird observatory at Rossitten on the Baltic, began banding operations in 1903 under the direction of Prof. Dr. J. Thienemann; and the Royal Hungarian Central Bureau for Ornithology started its work under the direction of Jacob Schenk at Budapest the same year. In 1904 the German Society established a second observatory at the naval base of Heligoland in charge of Herr Weigold. Prof. A. Landsborough Thomson began work in Scotland under the auspices of Aberdeen University in 1909, and the project of 'British Birds' magazine, under Mr. H. F. Witherby was inaugurated that year, as was also one in Russia under the direction of the Natural History Society, at Riga. Señor W. C. Tait at Oporto, Portugal, also commenced to band birds in 1909 but apparently did not press his work to any great extent.

In 1910 the Bavarian Ornithological Society and the Kroatian Natural History Society undertook banding work, and in 1911, Herr K. Daut, at Bern, Switzerland, and the Biological Society at Gothenburg, Sweden, started similar investigations. The latter of these was subsequently taken over by the Royal Natural History Museum, at Stockholm. In 1912 the Prussian forest officers were authorized by the Ministry of Agriculture, Lands, and Forests to band birds; and in 1913 Herr Tratz founded an ornithological station at Salzburg, where banding was carried on. The year 1914 seemed to dawn auspiciously for investigations of this character, as no less than four distinct projects were either

started or considered for future development. First the station of "Lotos" at Libock, in Bohemia, was founded; then the Leyden Museum took up the work in Holland under the guidance of Dr. Van Oort; the Imperial Russian Acclimatization Society for Plants and Animals founded an association at Moscow to mark birds; and Dr. Menegaux, of the French League for the Protection of Birds, outlined a plan for the consideration of that organization.

From the available figures these different organizations succeeded in banding approximately 170,000 birds. No complete records of the 'returns' received have been compiled but it would probably be about 3 or 4 per cent, or from 5,100 to 6,800 birds.

The history of bird banding activities in America is more or less known to the members of the A. O. U., because of the various papers on the subject that have appeared in 'The Auk.'<sup>1</sup> In these papers are mentioned the early experiments of Audubon, the work of Mr. P. A. Taverner, of Dr. John B. Watson, at Dry Tortugas, of the New Haven Bird Club, of Dr. Paul Bartsch, near Washington, D. C., and, in addition, several of the foreign projects outlined above.

As the immediate result of this pioneer work and through the efforts of Dr. Leon J. Cole, the American Bird Banding Association was formed in New York City, December 8, 1909, with a charter membership of over thirty.

This organization under the able guidance of its secretary, Mr. Howard H. Cleaves, continued to advance the work. From the fall of 1911 until early in 1920 it was conducted under the auspices of the Linnaean Society of New York, but in the latter year, having outgrown the available resources, it was formally taken over by the Bureau of Biological Survey of the U. S. Department of Agriculture.

Beginning in the year 1914 one of the most interesting chapters in the history of American bird banding activities was written

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<sup>1</sup> The more important of these are: "Suggestions for a Method of Studying the Migration of Birds." By Leon J. Cole, Third Ann. Rept. Mich. Acad. Sci., 1901, pp. 67-70. "The Tagging of Wild Birds as a Means of Studying their Movements." Leon J. Cole, Auk, XXVI, No. 2, April, 1909, pp. 137-143. "The Tagging of Wild Birds: Report of Progress in 1909." Leon J. Cole, Auk, XXVII, No. 2, April, 1910, pp. 153-168.

"What the American Bird-Banding Association has Accomplished During 1912." Howard H. Cleaves, Auk, XXX, No. 2, April, 1913, pp. 248-261.

by Mr. S. Prentiss Baldwin, of Cleveland, Ohio.<sup>1</sup> By means of traps of various types he conclusively demonstrated that through an efficient system of trapping a much larger percentage of "returns" might be secured than had been possible in the past when the killing of the bird had been depended upon for the recovery of the bands. Mr. Baldwin's experiments were carried out at his farm near Cleveland and at Thomasville, Georgia, and both of these stations are still in operation.

Turning now to a discussion of what may be learned through this method of investigation that is not possible by any other, we note at the outset that we are approaching the various questions from the aspect of the individual bird. We have each case complete in itself and by the coordination of many of these cases we can proceed to broader generalities. The 'return' record of a banded bird indicates that there were at least two times in its life when its whereabouts could be stated with precision. It therefore becomes axiomatic that the data secured from banded birds are incontrovertible. This evidence will bear on the problems both of migration and of life history.

Considering the former of these subjects and it will be noted that there is much mystery associated with the phenomenon of migration, which from the viewpoint of our present knowledge, can not be solved because of the lack of certain data.

To illustrate: The general speed at which a species advances or retreats during its periodic movements has been computed by means of the observations made by competent observers at different points along the route. But the exact number of miles that any one bird will travel in a day's journey, has not been ascertained, due, of course, to the impossibility of keeping the individual under observation. Moreover, it is not known whether any one flock or group of birds continually remains in the van, or whether the advance is made in a manner comparable to a game of leap-frog, successive groups 'jumping' over each other in alternate periods of rest and flight. The study of these so-called bird waves has attracted much attention in the past and their associ-

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<sup>1</sup> Bird Banding by Means of Systematic Trapping, by S. Prentiss Baldwin, from abstract of Proceedings, Linnaean Society of New York, No. 31, 1919, pp. 23-56.

ation with meteorological conditions has been more or less generally accepted. Banding records should elucidate this question and show accurately just what this relationship really is.

Again, to what extent do the individuals of a species follow the same route of migration in successive years, and is it the same for both spring and fall journeys? The importance of this question will be evident when it is considered that in the case of migratory waterfowl, the open seasons for shooting are during the time the birds are either on their winter feeding grounds or en route thereto. Consequently, data of this character will have an important bearing upon the enactment of appropriate laws for their protection.

Among other unanswered questions bearing on the subject of migration is whether those members of a species that breed farthest north, winter farthest south; in other words, whether they 'jump over' those members that breed in the intermediate zone which latter either make a much shorter migration or do not migrate at all. An observer at one point sees a general southward movement in the fall, while another, situated several degrees nearer the equator, finds the species stationary or at least present every month of the year. But the latter observer is unable to be sure that he sees the same birds continually in his latitude, nor is there any way in which he can decide this except by marking them. It is a well-known fact that with several species the young migrate separately and at a different time from the adults. This being true, do they segregate themselves to the extent of occupying different winter quarters? At this season the plumage is not always a safe criterion of age, and even the age of the bony structures can be determined only by an experienced anatomist.

Consideration of this last question will at once bring to mind the unsolved problem as to how long the individuals of any species remain on their winter feeding-grounds or in their breeding area, or how much time is consumed in travel between these two points. Neither is it known whether the individuals of all species return with regularity to winter in the same area. All these questions may be answered through trapping operations, since the birds frequenting any station will be registering ('repeating') their presence almost daily, and the dates of arrival and departure may therefore be stated with exactitude.

Another question that still awaits a satisfactory answer is: To just what extent and in what species, if not in all, is there a return to the site or vicinity of the nest of the previous year? Popular belief and some observations credit birds with an affinity for the old nest, but while it must be admitted that the theory is not untenable, it is by no means completely proved. Furthermore, if this theory be accepted in its entirety, consistency would demand the additional belief in the permanency of matings. If this hypothesis be rejected while still retaining the former, we are immediately confronted with the query as to which one of the pair is drawn by the magnet of the last-year's nest-site.

And what is the reason the young birds do not return (if true) to the region of the parental nest? Is the mortality heaviest among these yearlings, are they engaged in colonizing new districts near by, or do they constitute the vanguard of their species in the gradual extension of their range? Certain it is, that under normal conditions the avian population of an area is practically stationary. It has been found by actual count over a period of years that the number of breeding pairs will vary but little. Therefore, what becomes of the numerous offspring? As a suggestion, it may be that they winter in a different area from the adults and in going northward the next spring they enter a region *at a considerable distance* from that of their birth. They may even enter the territory of a different variety of the same species, or, on the other hand, they may strictly observe the confines of their own race and return to breed in the general vicinity of their own parental nest. The data that solve this problem may therefore have an all-important bearing on the subject of evolution with particular reference to the development of geographic races. Such information should also throw light on the effect of winter as well as summer environment on plumage changes.

The second group of problems on which data will be secured through this method of investigation is concerned with life histories. It will be at once apparent that the life histories of banded birds will be unique since in each case the information will pertain to a particular individual or a particular family.

Probably one of the most interesting subjects under this heading is the aforementioned permanency of matings. Mr. S. Pren-



tiss Baldwin has already studied the marital relations of the House Wren as presented elsewhere in the present number of 'The Auk,' and his conclusions may or may not be found to apply to other species. This theory, together with the supposed affinity for the nest site of the previous year, has gained considerable credence in the public mind, and while confirmatory proof is not entirely lacking, a great quantity of corroborative evidence is still needed before it can be completely accepted. Evidence on this subject may easily be collected with regard to those species that have shown a preference for nest boxes, since the banding of the entire family is comparatively simple, the nest box being readily converted into a temporary trap. Both the parents and their brood should be banded, and this should be done when the young are so well grown that there will be no danger of the parents' deserting them.

Although the banding of nestlings should be practiced at every possible opportunity there are certain features of this phase of the work that make it a less efficient method of operation than the systematic trapping of adults. One of the greatest disadvantages of the former method, is the high mortality rate among young birds. Probably the most precarious time in a bird's life is the period immediately after it leaves the nest. It has been estimated that only about 50 per cent of the young hatched actually reach maturity. It is therefore apparent that if this be true, many bands are wasted, and in addition, the record files contain many original data from which there can be no hope of returns but which must nevertheless be retained. An obvious advantage, however, is the collection of specimens of known age that will eventually be secured and which will be of incalculable value in studying the sequence of plumages and as an aid in determining the longevity of the individual. In banding young birds due regard must be given to their age. Young recently hatched should not be banded except under very exceptional circumstances; rather, the operator should wait until they are practically ready to leave the nest. At this time their tarsi will, in most cases, be fully grown or even over-grown, so that no allowance need be made for future growth.

The distance that birds will range from their nests in foraging for food has never been determined, and it should be a matter of

considerable interest. These data might be obtained from two or more adjoining trapping stations, or from one station alone if the operator would endeavor to locate the nests of the birds that frequent his traps. This information would also show the number of feedings per day and the preference of both adults and young for certain kinds of food. During the winter months birds are generally considered as more or less stationary, and it would be interesting to learn just how far they will wander from a known source of food supply. Visual observations in this case would supplement the trap records. The time spent in various activities is another item of interest in the study of life history, and the operator of a trapping station will have special opportunities to acquire such information.

The establishment of trapping stations is comparatively simple. Throughout the country there are many persons who feed the birds during the entire year. It will be seen that each of these feeding stations may readily be transformed into a trapping station without in any way detracting from its value as a source of avian food supply. It has been the observation of the author that if carefully handled, birds are neither injured nor unduly alarmed by being trapped. It is true that they are likely to struggle in the hand and some firmness is necessary to prevent injury, but the fact that many banded birds not only return to the trap, but do so again and again, is sufficient evidence that the treatment they received did not give them the fright or injury that some fear will result from this work.

While on this subject, the merits of the question as to the relative harm done to bird life through such operations may well be discussed. Occasionally birds will be injured or even killed through accidents in the trap or through careless or inexperienced handling, but such occurrences are so rare that they may be totally ignored. A band properly placed causes neither harm nor discomfort to the wearer. The word 'properly' must be emphasized, for an improperly placed band may readily cause trouble. If placed too tightly it may stop the circulation in the foot and so bring about a condition of paralysis; if placed too loosely, it may become caught on thorns or twigs. (This latter is applicable only to very small birds.) But the careful operator will rapidly

acquire such skill in handling the birds and in placing the bands that the number of casualties will be negligible.

There is absolutely no danger of bird banding leading to promiscuous slaughter. This is obvious when it is considered that no matter how complete the system or how enthusiastic the operator, the actual percentage of banded birds to the entire avian population will always remain so small that shooting for the sole purpose of securing banded birds would be ridiculous. Even on ducks and other large birds for which comparatively large bands are necessary, the bands are too small to be distinctly seen at the usual distance of observation without the aid of excellent field glasses under the most favorable conditions.

Although the bands used are considered as permanent marks, the use of the term 'permanent' must be qualified, since the habits, size, and relative strength of the different species will have a very important effect on the permanency of any artificial mark. For example, the use of an aluminum band on river ducks that spend the most of their time in fresh water, may be considered practically permanent, but with the salt-water diving ducks, the case is different. Alkalis attack aluminum in a manner comparable to the action of acid upon iron or copper, and in consequence the endurance of aluminum bands carried by waterfowl will be in inverse ratio to the length of time the birds spend in salt water. As an instance of this character I may mention that I have examined several bands that had been carried by ducks of various species for three or four years. The bands on those birds that followed the Mississippi valley as a migration highway and that nested near or on fresh water showed but ordinary wear, while those carried by the ducks that frequent Great Salt Lake, for example, were eaten away to the point of total obliteration of number and legend. In addition, crows, jays, and some of the larger finches are almost certain to make every effort to remove the band, and the stiffness of the metal or the locking device must therefore be of such nature as to defy their strength and ingenuity.

Nevertheless, it may be assumed that for this purpose aluminum bands are practically permanent. Therefore, the subjects for serious consideration are the methods of securing the birds for banding and for the return of the bands. Heretofore, by far the

greater number of birds banded have been fledglings and the 'returns' have been obtained through the chance killing of the bird at a later period by some person with sufficient knowledge and interest to comprehend the meaning of the band and to forward it to the proper authorities. That this method has not been devoid of results, we know, but the percentage of 'returns' has been low, and furthermore, there are but two positive dates, that of banding and that of capture, which latter has almost invariably meant the death of the carrier. With some species, it is still believed that this procedure will have to suffice to a considerable extent, for in the case of migratory game birds there can be no question that many of our 'returns' will be sent in by sportsmen. But even with these more systematic methods are possible.

In conclusion it may be stated that a variety of methods must be employed for no one system will apply to all cases. For many of the ground-loving species the Government sparrow-trap, with slight modifications, has proved excellent. Other sparrow traps now on the market have not been extensively tried but probably many of them may be successfully used. The use of some device for throwing a net over a baited area, and thus catching an entire flock, should prove particularly satisfactory for those birds that have a distinct aversion to going under anything, such as shorebirds. For ducks and other waterfowl, still different schemes must be employed, but satisfactory traps are too well known to allow any doubt as to the success of the operator who works with these birds.

The use of the 'jack-light' has scarcely been tried in this country, but it might be a most successful method of operating in breeding colonies of Herons, Ibises, Gulls, Terns, Pelicans, and other birds with the communal habit.

With the element of anticipation always present, expecting and watching for a bird marked at some other station or during a previous year, it seems that this new system of bird banding should find a host of enthusiastic participants. The Biological Survey is prepared to assist in the construction of traps, with information about those that have been successfully operated, and will issue the bands and forms to be used in recording the data.

Special Federal permit for this work is required under the provisions of the Migratory-Bird Treaty Act. Application for permit and full information relative to the work may be secured by addressing the Bureau of Biological Survey, U. S. Department of Agriculture, Washington, D. C.

*Biological Survey, Washington, D. C.*

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## RECENT RETURNS FROM TRAPPING AND BANDING BIRDS

BY S. PRENTISS BALDWIN

### 1. OPERATIONS AT CLEVELAND, OHIO.

The methods used by the writer, for trapping and banding birds have been fully explained in an article published by the Linnaean Society of New York in 1919.<sup>1</sup> Briefly it may be explained that by means of the so-called Government sparrow-trap, and by the use of trap nest boxes, adult wild birds are caught, aluminum bands bearing address and numbers for identification are placed on the legs of these birds and they are then released. During the last six years many hundreds have been thus banded and many thousands handled by the writer; and many have been re-taken again and again the same season and succeeding seasons.

The publication above referred to contains, besides a description of methods, a report of the returns of birds to and including the year 1918. The following report includes only the "returns" of the years 1919 and 1920. Those who have a copy of the previous report may be interested to know that three of the birds described therein, were taken three years later, in 1920, and appear in this report. These are Brown Thrasher, number 19247; Red-bellied Woodpecker, number 31778; and White-throated Sparrow, number 38160. An additional report for House Wren number 44008 is also contained in the following pages.

*Handling Wild Birds.*—Two positions for holding birds are described and illustrated on page 27 of the 'Proceedings.' Per-

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<sup>1</sup> Proceedings of the Linnaean Society of New York No. 31, 1919.